APPENDIX E

COMPLIANCE ASSURACE MONITORING PLANS FOR LARGE PSEUS

COMPLIANCE ASSURANCE MONITORING PLAN
KENTUCKY NEWGAS ▪ CENTRAL CITY, KENTUCKY

Prepared by:

TRINITY CONSULTANTS
1717 Dixie Highway, Suite 900
Covington, Kentucky 41011
(859) 341-8100
www.trinityconsultants.com

Project 071801.0034

For:

KENTUCKY NEWGAS
701 Market St., Suite 300
St. Louis, MO 63101
(314) 342-7613

October 2009

Trinity Consultants

1. INTRODUCTION 1-1
1.1 CAM APPLICABILITY 1-1
1.2 CAM PLAN REQUIREMENTS 1-3

2. CAM PLAN – FLARE 2-1
2.1 CAM BACKGROUND 2-1
2.2 CAM PLAN SUBMITTAL REQUIREMENTS 2-2
2.3 CAM PLAN SUMMARY 2-3

3. CAM PLAN – AGR VENT 3-5
3.1 CAM BACKGROUND 3-5
3.2 CAM PLAN SUBMITTAL REQUIREMENTS 3-7
3.3 CAM PLAN SUMMARY 3-9

As part of the initial Title V application process, Kentucky NewGas has evaluated the applicability of the Compliance Assurance Monitoring (CAM) rule, established in 40 CFR Part 64 on November 21, 1997.[1] Under the CAM regulations, facilities are required to prepare and submit monitoring plans for certain emission units to provide on-going and reasonable assurance of compliance with emission limitations. Based on the complete CAM applicability analysis presented in Section 1.1 below, Kentucky NewGas has determined the flare (EP-1) and Acid Gas Removal (AGR) Vent (EP-5) are the only large pollutant specific emission units (PSEU) that are subject to the requirements of the CAM rule. The CAM Plan for these units, drafted in accordance with all applicable provisions of 40 CFR Part 64 and based on the U.S. EPA August 1998 CAM Technical Guidance Document, are provided in Section 2.[2] For other PSEUs, CAM applicability determinations and any necessary CAM Plans will be submitted as part of the first significant permit revision that involves a large PSEU or as part of the first renewal application for all PSEUs.

1.1 CAM APPLICABILITY

1.1.1 CAM APPLICABILITY CRITERIA

Per 40 CFR §64.2(a), the CAM regulations apply to a PSEU, as defined in 40 CFR §64.1, at a major Title V source if the PSEU: 1) is subject to an emission limitation or standard for the regulated pollutant, other than an emission limitation or standard that is exempt under §64.2(b); 2) uses a control device, as defined in 40 CFR §64.1, to achieve compliance with the emission limitation; and 3) has potential pre-controlled emissions of the applicable regulated air pollutant that are equal to or greater than the Title V major source threshold.

1.1.2 CAM APPLICABILITY EXEMPTIONS

The CAM regulations specifically exempt certain emission limits from being considered for CAM applicability. Specifically, limits or standards proposed by U.S. EPA after November 15, 1990, pursuant to section 111 and section 112 of the Clean Air Act are exempted.[3] Emission limits for which "a part 70 or 71 permit specifies a continuous

---

[1] Pursuant to 40 CFR §64.5, only CAM plans for large pollutant specific emission units (i.e., emission units with the potential to emit considering controls greater than the Title V major source threshold) are required to be submitted with the initial Title V application, and CAM plans for all other pollutant specific emission units are not required to be submitted until the Title V renewal deadline.

[2] U.S. EPA, *Technical Guidance Document: Compliance Assurance Monitoring*, August 1998.

[3] 40 CFR 64.2(b)(1)(i)

compliance determination method, as defined in §64.1" are also exempt.[4] Per §64.1, the definition of a continuous compliance determination method is:

> *...a method, specified by the applicable standard or an applicable permit condition, which: (1) Is used to determine compliance with an emission limitation or standard on a continuous basis, consistent with the averaging period established for the emission limitation or standard; and (2) Provides data either in units of the standard or correlated directly with the compliance limit.*

1.1.3 CAM APPLICABILITY DETERMINATION

For the CAM applicability determination, all emissions units at the facility were first reviewed to identify those that rely on control devices to achieve compliance with an emission limitation or standard. The controlled potential emissions for the identified units were then compared to the Title V major source thresholds (i.e., 100 tpy of any regulated pollutant, 10 tpy of any individual HAP, and 25 tpy of combined HAPs) to identify large PSEUs. For all units with controlled potential emissions exceeding the Title V major source threshold, the list of potential exemptions identified in Section 1.1.2 were then reviewed and applied as necessary.

Based on this CAM applicability determination approach, the following large emission PSEU was determined to be exempt from the CAM rule for the reasons cited:

- **ATS Unit** (EP-2): Although potential emissions of NO_X from the ATS unit are greater than 100 tpy, Kentucky NewGas is not proposing to install a control device for the ATS unit that specifically targets NO_X. Although low-NO_X burners will be utilized in the ATS incinerator to reduce NO_X formation, passive control measures that prevent pollutants from forming, such as the "use of combustion or other process design features or characteristics", do not constitute a control device as defined in the CAM rule.[5]

Based on this CAM applicability determination approach, the only large PSEUs at the Kentucky NewGas facility subject to the CAM rule are the flare and AGR vent for the reasons cited:

- **Flare** (EP-1): The flare is considered large PSEU for CO (i.e., controlled potential emissions are greater than 100 tpy) due to emissions generated during planned startup and shutdown events. It is anticipated that the air permit will contain federally enforceable CO emission limits issued under the PSD program for the flare. Therefore, CAM must be addressed in this initial Title V application for CO emissions from the flare. Pre-controlled potential emissions of all other regulated air pollutants are less than 100 tpy, so the flare is only a PSEU for CO.

---

[4] 40 CFR 64.2(b)(1)(vi)

[5] 40 CFR 64.1

- **AGR Vent** (EP-5): The AGR Vent will be routed to an oxidizer system to destroy nearly all of the CO (and VOC) present in the exhaust stream. The controlled potential emissions of CO from the AGR Vent are greater than 100 tpy and this emission unit is subject to an emission limit pursuant to a BACT evaluation. Therefore, Kentucky NewGas has developed a CAM plan and will work with KDAQ to ensure that the appropriate CAM permit conditions for the AGR Vent are integrated into the Title V permit. Section 2 contains the CAM Plan for the thermal or catalytic oxidizer system proposed for the AGR Vent.

1.2 CAM PLAN REQUIREMENTS

To provide a reasonable assurance of compliance with emission limitations or standards for the anticipated range of operations at a PSEU, the CAM plan submittal must 1) identify the control device monitoring approach, 2) identify the indicator range or value to be maintained and, 3) provide the rationale for selecting the monitoring approach and the indicator range or value. The intent of the CAM plan is to provide a succinct summary of the monitoring procedures the source has implemented to comply with the CAM requirements in 40 CFR Part 64, such that the permitting authority should be able to review the plan and assess whether the proposed monitoring approach complies with the CAM requirements. The control device monitoring procedures outlined in the CAM plans that follow will be implemented at the proposed plant. Federally enforceable permit conditions that require Kentucky NewGas to conduct these procedures in accordance with control device manufacturer's specifications will be included in Kentucky NewGas' air permit and will be followed on a continuous basis.

2.1 CAM BACKGROUND

2.1.1 EMISSION UNIT

Description: Flare

Identification: Off-specification process gas from gasifier rotations and planned startups and shutdowns and flare pilots.

Facility: Kentucky NewGas

2.1.2 APPLICABLE REGULATIONS, EMISSION LIMITATIONS, AND MONITORING REQUIREMENTS

Regulation/ Emission Limit: *401 KAR 51:017 (Prevention of Significant Deterioration of Air Quality)* – Proposed CO BACT Limit: 500.8 lb/hr on a 30-day rolling average basis and 604.5 tpy on a 365 calendar day basis.

Current Monitoring Requirements: Continuous pilot flame detection using a thermocouple or other equivalent device
Inlet flow rate using a monitoring device that takes at least four readings per hour
Visible emissions monitoring on a monthly basis or when the flare is processing off-specification process gas. Determine visible emissions consistent with Method 22.

2.1.3 CONTROL TECHNOLOGY

The off-specification process gas will be routed to a well-designed elevated flare capable of achieving a DRE for CO of at least 98 percent. Proper flare design includes specifications to maintain availability and efficiency. Kentucky NewGas will maintain the flame integrity through the implementation of good combustion practices and flame detection monitoring with an automatic reignition system. Since the combustion efficiency (i.e., destruction/removal efficiency) of a flare is primarily influenced by temperature, residence time, and the mixing of air and process gases in the combustion zone, implementation of these design considerations and the use of a gas-fired pilot flame will support a flare design that maximizes efficiency and minimizes incomplete combustion. An elevated smokeless flare with flame detectors, automatic reignition system, and a gas-fired pilot is being proposed for handling CO emissions present in off-specification process gas.

Kentucky NewGas will conduct an initial flare assessment. The initial flare assessment will be important to verify that the flare is operating in accordance with manufacturer's specifications and is, therefore, achieving the stated DRE for CO. A continuous parametric monitoring system (CPMS) will be installed, operated, and maintained for measuring the flow rate of flared gases in accordance with manufacturer's specifications. The CPMS will be designed to correct for temperature and pressure and the output from the CPMS will be flow rate of flare gases in standard conditions.

2.2 CAM Plan Submittal Requirements

The monitoring approach described below includes all of the information as required by 40 CFR §64.4.

2.2.1 Rationale for Selecting Performance Indicators

The continuous presence of pilot flame at all times will indicate proper operation of flare by ensuring that the off-specification process gas will be flared prior to being vented to the atmosphere. A thermocouple will be used to detect the continuous presence of pilot flame at the Kentucky NewGas facility.

An initial flare design assessment will be performed. The net heating value of the off-specification process stream will be estimated during this design analysis. The net heating value is also an important parameter to ensure proper flaring of waste stream components and maintaining high destruction efficiency. Auxiliary fuel (for increasing the heating value of flare gas) may also be utilized during certain flaring events if recommended by the flare manufacturer.

The Kentucky NewGas facility will install, operate, and maintain an inlet gas flow meter to assess compliance with the proposed CO BACT emission limitation. Monitoring the inlet off-specification process gas flow rate to the flare and ensuring that it remains within acceptable limits will enable the flare to operate with optimum control efficiency in accordance with the manufacturer's design. Periodic visible emissions monitoring will also be conducted to ensure proper operation of the flare.

2.2.2 Rationale for Selecting Indicator Range

If the flare pilot flame is not lit when off-specification process gas is routed to the flare, uncombusted (i.e., uncontrolled) process gases would escape through the flare tip directly to atmosphere. Therefore, it is imperative to ensure the pilot flames are lit (supplying an ignition source for process gases) at all times. Using flow monitors to estimate the CO loading to the flare provides a direct indication of actual CO emissions from the flare assuming the flare is achieving its design DRE. Finally, the presence of visible emissions from the flare exceeding the applicable opacity limit from 401 KAR 63:015 (an opacity of visible exceeding 20 percent for more than 3 minutes in a 24-hr period) may indicate incomplete combustion is occurring at the flare tip and the flare is not achieving it optimum CO destruction efficiency.

2.3 CAM PLAN SUMMARY

The key elements of the monitoring approach, including the indicators to be monitored, indicator ranges, and performance criteria are summarized in the Table 3-1.

TABLE 3-1. FLARE MONITORING APPROACH SUMMARY

Indicator	
Parameter	Presence of pilot flame, continuous flow monitoring, and periodic visible emissions monitoring.
Measurement Approach	Use of thermocouple or other equivalent device for pilot flame detection, continuous flow monitor, and human observations for visible emissions.
Indicator Range	
	Absence of pilot flame, presence of visible emissions with an opacity of greater than 20 percent for more than three (3) minutes in any one (1) day, or an off-specification process gas flow rate causing the 30-day rolling average CO emission limit to be exceeded will all be considered excursions from normal operation.
Performance Criteria	
Data Representativeness	Maintaining a lit pilot flame at all times process gases are routed to a flare ensures combustion will occur at the flare tip. Monitoring the flow rate and estimating or measuring the composition of process gases routed to the flare provides an indicator of the inlet pollutant loading and thus flare emissions given a certain design DRE. Finally the presence of visible emissions can indicate poor combustion and therefore poor CO destruction efficiency.
Verification of Operational Status	Records of continuous pilot flame detection system readings, inlet process gas flow measurements, and visible emissions observations will be kept onsite and made available for inspection.
QA/QC Practices and Criteria	Kentucky NewGas will follow the manufacturer's recommendations for installation, operation, maintenance, and calibration of the pilot flame detection device and the inlet process gas flow monitoring system. To ensure that monitoring device malfunctions do not prevent the collection of accurate data, spare parts will be kept onsite and operators will replace malfunctioning components of these monitoring systems if necessary as soon as is practicable once a malfunction is recognized.
Monitoring Frequency and Data Collection Procedures	The presence of a pilot flare will be monitored and recorded continuously. Process gas flow rate will be measured continuously and recorded in 15-minute periods to determine the 24-hr block average using appropriate process control systems.
Corrective Action	The pilot flame detection system will be equipped with an alarm to alert operators to the absence of a pilot flame. When the pilot flame is extinguished or visible emissions exceeding the opacity limit are observed, operators will check the flare to ensure proper operation. If any of these checks indicate abnormal operation, Kentucky NewGas will inspect all potentially malfunctioning components of the offending system. Once the source of the malfunction is determined, the problem will be remedied as soon as practicable after the malfunction is recognized by repairing or replacing the malfunctioning component of the system.

3.1 CAM BACKGROUND

3.1.1 EMISSION UNIT

Description:	AGR Vent Routed through a Closed Vent System to Either a Catalytic Oxidizer System or Regenerative Thermal Oxidizer System
Identification:	H_2S and CO_2 are removed from sour syngas in a methanol-based Rectisol® unit. CO_2 in the rich methanol is flashed in two stages with both streams venting to EP-5.
Facility:	Kentucky NewGas

3.1.2 APPLICABLE REGULATIONS, EMISSION LIMITATIONS, AND MONITORING REQUIREMENTS

Regulation/ Emission Limit:	*401 KAR 51:017 (Prevention of Significant Deterioration of Air Quality)* – Proposed CO BACT Limit: 33.6 lb/hr on a 3-hour block average basis
Current Monitoring Requirements:	Continuous combustion temperature monitoring within RTO combustion chamber at all times while the emission unit is in operation, OR Continuous temperature monitoring of the preheated AGR vent gas at the inlet to the catalyst bed at all times while the emission unit is in operation Annual burner inspections Operation and maintenance of continuous monitoring device Installation and operation of a closed vent system

3.1.3 CONTROL TECHNOLOGY

The CO_2-rich vent gas stream from the solvent regeneration section of the AGR will be routed to an oxidizer system through a closed vent system. As noted in the BACT analysis for the AGR vent, Kentucky NewGas has received budgetary quotes from both catalytic oxidation (CatOx) and regenerative thermal oxidizer (RTO) vendors which guarantee a destruction/removal efficiency (DRE) for CO (and VOC) of greater than 99 percent given the composition and flow rate of the AGR vent stream. Since both types of oxidizers are capable of achieving the same level of control for CO (and VOC) and neither control option poses significant adverse energy and environmental impacts, CatOx and RTO can

be treated as equivalent technologies for the purposes of establishing a BACT emission limitation. Certain non-air quality related factors influencing the selection of the preferred oxidizer technology (including project economics, operation and maintenance procedures for each device, and plot space requirements) have not been fully developed and considered given the current stage of the project design. Therefore, Kentucky NewGas has not committed to utilizing a particular oxidizer technology in this air permit application. As discussed in the following subsections, CatOx and RTO are similar enough from a theoretical standpoint that the proposed performance indicator and indicator monitoring approach in this CAM plan is valid regardless of which technology is ultimately selected.

The following preliminary information on the CatOx system was obtained from one of the primary vendors:

Inlet Design Parameters:[6]

- Inlet flow rate = 240,000 standard cubic feet per minute (scfm);
- Inlet flow rate = 184,000 actual cubic feet per minute (acfm);
- Inlet CO loading = 2,663.45 lbs/hr as CO;
- Inlet process pressure = 20 psia / 5.4 psig; and
- Inlet gas temperature before preheating = 85°F.

CatOx Specific Data:

- Operate two (2) CatOx units in parallel;
- CatOx Inlet Pressure = 3 psig;
- Pressure Drop = 1-2 psig;
- Inlet concentration of sulfur compounds $\leq$ 20 g/ft^3 of catalyst;
- Maximum rating of burner to heat stream = 20 MMBtu/hr;
- Heat recovery = 65-75%;
- Catalyst volume = ~150 ft^3 per chamber;
- Design destruction/removal efficiency of CO and MeOH = 99 %;
- Inlet gas temperature after preheating = 600°F;
- Outlet gas temperature from the Catalyst Bed = 700-1,000°F; and
- Exhaust gas temperature range = 270-300°F.

[6] The process gas flow rate and VOC loading for each CatOx unit and for the two (2) RTO units (referenced in Table 1 of the CSM proposal and on page 6 of the Adwest proposal, respectively) are based on a preliminary version of the AGR HMB which is slightly different than the HMB used for emission calculations. Through communications with CSM and Adwest subsequent to the issuance of the proposal, Kentucky NewGas has confirmed that these changes will not affect their performance guarantee.

The following preliminary information on the RTO system was obtained from one of the primary vendors:

Inlet Design Parameters:

- Inlet flow rate = 284,032 scfm (196,032 scfm from process and 88,000 scfm from make-up air);
- Inlet solvent loading = 7,124 lbs/hr of H_2, CH_4, CO, MeOH, H_2S, COS, and HCN;
- Inlet solvent heat of combustion = 15,500 Btu/lb net;
- Inlet gas temperature before preheating = 85°F; and
- Pressure upstream of oxidizer = -2.0 inches of w.c.

RTO Specific Data:

- Operate five (5) Dual Chamber RTO Systems in parallel;
- No supplemental fuel combustion required to heat stream;
- Natural gas-fired startup pre-heater for rapid 1-hour cold startup;
- Maximum heat input capacity of startup preheater = 14.7 MMBtu/hr;
- Heat Recovery = 95%;
- Pressure Drop = ~2 inches of w.g.;
- Design destruction/removal efficiency of CO and MeOH = 99%;
- Design minimum combustion chamber temperature = 1,500°F;
- Design maximum combustion chamber temperature = 2,000°F.

3.2 CAM Plan Submittal Requirements

The monitoring approach described below includes all of the information as required by 40 CFR §64.4.

3.2.1 Rationale for Selecting Performance Indicators

Incineration or thermal oxidation is the process of oxidizing combustible waste gases by heating the waste gas stream to above its auto-ignition temperature in the presence of oxygen for a sufficient duration to completely combust all organic compounds to carbon dioxide and water. Important design factors include residence time, temperature, and turbulence. Time, temperature, turbulence, and oxygen concentration govern the completeness of combustion. Of these, only temperature and oxygen can be significantly controlled after construction. Use of a catalyst accelerates the rate of oxidation and allows for CO and VOC destruction at lower temperatures. Because oxidation occurs at lower temperatures, less supplemental fuel is required to obtain the desired heat input for combustion.

For both CatOx and RTO, combustion temperature is an indication of the effectiveness of the combustion processes occurring within the catalyst bed or combustion chamber, respectively, where low temperatures can indicate the potential for insufficient destruction of CO and VOC. Maintaining the combustion chamber temperature at or above a minimum level based on manufacturer's recommendations and verified during the

performance test ensures that the emission limit established as BACT is being achieved on a continuous basis.

The proposed work practices of annual burner inspections and periodic flame observations verify equipment integrity and ensure proper oxidizer operation and efficiency.

Another important performance indicator is utilizing a closed vent system as a method for ensuring 100% capture efficiency. An appropriate definition of a closed vent system is shown in 40 CFR §63.111 as:

> "*Closed Vent System* means a system that is not open to the atmosphere and is composed of piping, ductwork, connections, and, if necessary, flow inducing devices that transport gas or vapor from an emission point to a control device."

The AGR vent gases generated in the solvent regeneration process within the AGR are routed through piping directly to the inlet of the oxidizer and therefore comply with the definition of a closed vent system. As a result, 100% capture is achieved on a continuous basis.

3.2.2 RATIONALE FOR SELECTING INDICATOR RANGE

The selected indicator range for the oxidizer temperature was set based on vendor information and compliance with the associated parametric operating limit will be assessed during the initial performance test. The indicator range is a minimum combustion chamber or catalyst bed inlet temperature value and measured temperature(s) during a 15-minute period will be used to calculate the 3-hour block average combustion chamber temperature reading. A 3-hr block average temperature below the CatOx and RTO indicator ranges will define an excursion.

As shown in the excerpt from the Adwest proposal provided in Appendix F of the air permit application for the Kentucky NewGas facility, a typical RTO minimum combustion chamber temperature to ensure proper operation is 1,500°F, and therefore, Kentucky Syngas proposes to include this as a 3-hr block average operating limit in the permit.

CSM Worldwide, the preferred vendor for a catalytic oxidizer, also confirmed that the minimum inlet temperature to the catalyst bed will be 600°F, and therefore, Kentucky Syngas proposes to include this as a 3-hr block average operating limit in the permit. For both the Adwest and CSM oxidizer systems, maintaining the combustion temperature above the specified minimum value ensures 99 percent DRE for CO (and VOC). A performance test conducted in accordance with EPA reference Method 10 will be conducted to assess compliance with the proposed BACT limit on an annual basis. Combustion chamber and catalyst bed temperature measurements collected during each stack test run will confirm that maintaining the combustion chamber above the indicator range allows the oxidizer system for the AGR Vent to achieve the established BACT emissions limit for CO.

3.3 CAM PLAN SUMMARY

The key elements of the monitoring approach, including the indicators to be monitored, indicator ranges, and performance criteria are summarized in the Table 2-1.

TABLE 2-1. AGR OXIDIZER MONITORING APPROACH SUMMARY

Indicator	
Parameter	Combustion chamber temperature (or catalyst bed inlet temperature) and annual burner inspection.
Measurement Approach	Measurement of combustion chamber temperature (or catalyst bed inlet temperature) by use of a thermocouple. Periodic inspection and maintenance of the oxidizer burners in accordance with manufacturer's specifications
Indicator Range	
	The minimum combustion chamber temperature indicative of normal operation for the RTO, 1,500 °F, was established based on manufacturer's recommendations and will be verified during the initial performance test. The minimum catalyst bed inlet temperature indicative of normal operation for the CatOx, 600 °F, was established based on manufacturer's recommendations and will be verified during the initial performance test. Any 3-hour block average combustion temperature reading below these minimum limits will be considered an excursion. Failure to conduct annual burner inspections or periodic flame observations is also considered an excursion.
Performance Criteria	
Data Representativeness	The rate at which VOC and CO are oxidized is greatly affected by temperature (i.e., the higher the combustion temperature the faster the rate of endothermic oxidation reactions). Therefore, the temperature monitoring device will be located in the combustion zone (or piping at the inlet to the catalyst bed). The tolerance of the thermocouple and the sensitivity of the recordkeeping system will be determined based on manufacturer's recommendations.
Verification of Operational Status	Records of continuous combustion temperature readings will be kept onsite and made available for inspection.
QA/QC Practices and Criteria	Kentucky NewGas will follow the manufacturer's recommendations for installation, operation, maintenance, and calibration of the temperature monitoring device. To ensure that monitoring device malfunctions do not prevent the collection of accurate combustion temperature data, spare thermocouples will be kept onsite and operators will replace malfunctioning thermocouples if necessary as soon as is practicable once a malfunction is recognized.
Monitoring Frequency and Data Collection Procedures	The combustion temperature will be monitored continuously and recorded in 15-minute periods to determine the 3-hour block average using appropriate process control systems.

TABLE 2-1. AGR OXIDIZER MONITORING APPROACH SUMMARY (CONT.)

Corrective Action	When an out of range temperature reading occurs, operators will check the oxidizer system to ensure proper operation. If any of these checks indicate abnormal operation, Kentucky NewGas will inspect all potentially malfunctioning components of the offending system. Once the source of the malfunction is determined, the problem will be remedied soon as practicable after the malfunction is recognized by repairing or replacing the malfunctioning component of the system.

APPENDIX F

SUPPORTING INFORMATON FOR BACT ANALYSIS